Process Evaluation Section

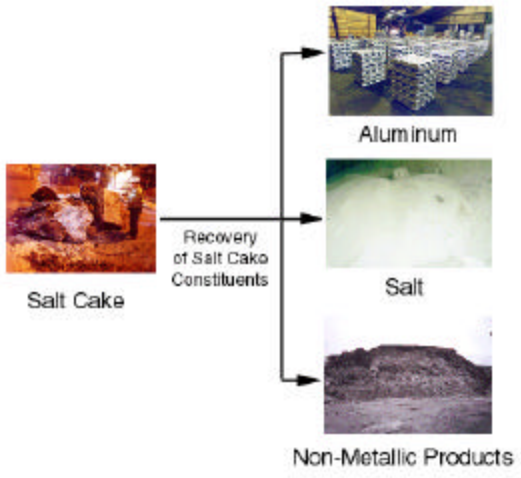
Recycling Aluminum Salt Cake

Problem/Opportunity

Recycling aluminum saves significant amounts of energy. However, processing of recycled aluminum generates a salt cake waste stream consisting of aluminum, salt and oxide residue (non-metallic product [NMP]). The increasing cost and environmental concerns associated with salt cake disposal threaten the economic viability of the aluminum recycling industry. Salt cake treatment processes are being developed to address this problem. For example, salt cake can be recycled by crushing and screening to recover the entrained aluminum, dissolving the soluble salts in water, filtering to recover the NMP, and recovering the salts by evaporation of the process brine. These processes tend not to be cost-effective because of the high energy costs associated with salt recovery and because the oxide residue fraction is still landfilled. Thus, an opportunity exists to develop an economically attractive salt cake treatment process that will recover the salt cake constituents, recycle the aluminum and salt fractions, and convert the oxide residue fraction to high-value-added products. An economical salt cake treatment process will eliminate the 1,000,000-ton-per-year salt cake waste stream, save over 20 trillion Btu per year .

Approach

Argonne is working with an industrial partner in the aluminum industry, Alumitech, to develop a cost-effective process to recycle aluminum salt cake. The work is funded by the U.S. Department of Energy, Aluminum Industry of the Future Program.



Components of Salt Cake

Because salt recovery by evaporation alone is the most capital- and energy-intensive step in conventional salt cake recycling technology, new processes for the recovery of salt from process brines have been proposed and evaluated. On the basis of these evaluations, we have selected for development a salt recovery process based on electrodialysis technology. In electrodialysis, an applied electric field causes ions to pass from one solution to another through semi permeable membranes. By alternating cation-selective and anion-selective membranes, it is possible to cause one solution to become concentrated in salt, while depleting salt from the other solution. In our process, electrodialysis is used to transport salt from the process brine to a salt-saturated solution. The concentrated brine is then fed to a

smaller evaporator. This technology is less energy intensive and has lower capital costs than direct evaporation technology.

We are also working with the aluminum industry to develop processes that convert salt cake oxide residue to high-volume products, such as an alternative alumina source for ironmaking, and high value-added products, such as ceramic fiber insulation, abrasives, and refractory aggregate for use in high alumina refractories.

Results

A full-scale electrodialysis pilot plant has been constructed, and experiments are underway to determine whether the process is economically viable. Innovative solutions to several technical problems are also being incorporated into the process. Alumitech has successfully converted NMP into calcium aluminate, an engineered material designed to achieve several advantages over other materials in the market place. Conversion of oxide residue to fiber insulation products has also been completed, and the process is in commercial demonstration.

Future Plans

Completion of pilot-scale testing of the electrodialysis-based process for the recovery of salt cake constituents and initiation of the demonstration plan and commercialization strategy are expected in FY 2001.